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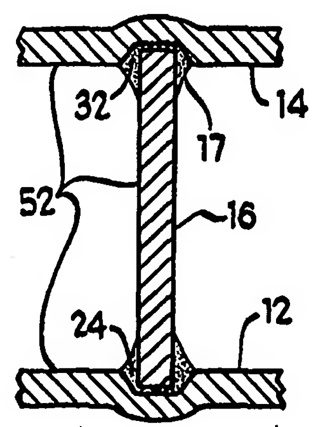
(54) Title: ALUMINUM TORQUE CONVERTER APPARATUS AND METHOD FOR MANUFACTURING SAME

(57) Abstract

A torque converter apparatus (10) includes a shell (12), a shroud (14), turbine blade (16) and means (17) for joining the turbine blade (16) to the turbine shell (12) and to the turbine shroud (14). The shell (12) includes at least one accepting region. The shroud (14) likewise includes at least one accepting region. The turbine blade (16) includes an upper region and a lower region. The upper region engages the accepting region of the shroud and the lower region engages the accepting region of the shell. The joining means (17) facilitates the joining of the turbine blade to the turbine shell and the turbine shroud. The invention also includes a method for manufacturing the torque converter.



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TITLE OF THE INVENTION DISCLOSURE

ALUMINUM TORQUE CONVERTER APPARATUS AND METHOD FOR MANUFACTURING SAME

BACKGROUND OF THE INVENTION DISCLOSURE

1. Field of the Invention Disclosure

The present invention is directed to torque converters and, more specifically to torque converters used in automatic transmission powertrains of the type which are typically installed in automobiles and trucks. Further, the invention also comprises a method of manufacturing a torque converter.

2. Background of the Invention Disclosure

Torque converters for automatic transmissions have been known in the art for many years. Such conventional devices are typically used in automatic transmission powertrains which are installed in automobiles, light trucks, as well as in Class 6 and Class 8 heavy trucks. Such a conventional torque converter is shown in Figs. 1 and 2 as comprising shell 110, shroud 115, turbine blades, such as turbine blades 120, and hub 125. As can be seen in Fig. 2, shell 110 and shroud 115 are positioned at either side of typical turbine blade 120 and joined at mating region 130.

These torque converters have traditionally been made from stamped-steel components. However, the use of steel components limits potential maximum output efficiency due to the weight of steel and the attachment structure of the steel components.

Similarly, the method for making such conventional torque converters has been known in the art for many years. The method has generally involved

stamping components of the torque converter (generally comprised of steel), such as the turbine shell, shroud, and blades, on a production line. The mechanical interlocks between blade tabs and shell and/or shroud are typically produced on offline rotary notching and embossing machines. Once fully formed, final assembly is then generally completed using high speed tab rolling machines. This conventional method for manufacturing the converters is inefficient, and, costly inasmuch as the method requires many manual, labor intensive, operations in addition to automated processes. A typical blade-to-shell and blade-to-shroud connection of a fully assembled torque converter is shown in Fig. 2. As can be seen, current manufacturing techniques for attaching turbine blade 120 to shroud results in gap 131 of gap region 130 (Fig. 2). In operation, transmission fluid passes undesirably through this gap, and, consequently, losses in efficiency are experienced, through reduced contact pressure. The end result is that output torque is adversely affected.

SUMMARY OF THE INVENTION

A torque converter apparatus comprising a turbine shell, a turbine shroud, at least one turbine blade and means for joining. The turbine shell includes at least one accepting region. The turbine shroud includes at least one accepting region. The at least one turbine blade has an upper region and a lower region. The upper region engages the at least one accepting region of the turbine shroud. The lower region engages the at least one accepting region of the turbine shell. The joining means attaches the upper region of the blade to the shroud and the lower region of the blade to the shell. In a preferred embodiment, the joining means comprises cladding positioned on at least a portion of the upper region and the lower region of the turbine blade. Additionally, the joining means comprises cladding positioned on at least a portion of the at least one accepting region of each of the turbine shell and the turbine shroud.

In another preferred embodiment, the shell includes an outer perimeter and an inner perimeter. The turbine blade extends from the outer perimeter to the inner perimeter of the turbine shell. Additionally, the turbine shroud includes an outer perimeter and an inner perimeter. The turbine blade extends from the outer perimeter to the inner perimeter of the turbine shroud.

In another preferred embodiment, the at least one turbine blade comprises a plurality of turbine blades spaced evenly about the turbine shell and turbine shroud. The invention additionally comprises a method of manufacturing a torque converter which comprises the steps of (1) forming a turbine shell having at least one accepting region; (2) forming a turbine shroud having at least one

accepting region; (3) forming at least one turbine blade; (4) positioning a portion of the at least one turbine blade into the at least one accepting region of the turbine shroud; (5) positioning a portion of the at least one turbine blade into the at least one accepting region of the turbine shell; (6) heating the at least one turbine blade, turbine shell and turbine shroud in a furnace; and (7) chemically and metallurgically joining the turbine blade to the turbine shell and shroud through the application of heat.

In a preferred embodiment, the step of forming the turbine shroud may comprise the step of stamping a stock material to a desired configuration. Additionally, the step of forming the shell may comprise the step of stamping a stock material to a desired configuration.

Moreover, in a preferred embodiment, the step of forming the at least one turbine blade may comprise the step of stamping a stock material into the desired configuration.

In another preferred embodiment, the at least one turbine blade comprises a plurality of turbine blades, and the step of positioning a portion of the at least one turbine blade into the shell may comprise the step of positioning one of the plurality of turbine blades into each of the accepting regions of the shell.

Preferably, the step of positioning a portion of the at least one turbine blade into the turbine shroud may comprise the step of positioning a turbine blade into each of the accepting regions of the turbine shroud.

In yet another preferred embodiment, the step of heating may comprise the step of placing the attached turbine shell, shroud and blade into a CAB furnace for

a predetermined period of time.

In a preferred embodiment, the method may comprise the step of clamping the turbine shell, shroud and blade, prior to the step of heating, to prevent inadvertent detachment of same.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 of the drawings is a top plan view of a prior art torque converter.

Fig. 2 of the drawings is a cross-sectional view of a prior art torque converter taken about lines 2-2 of Fig. 1.

Fig. 3 of the drawings is a cross-sectional view of the present torque converter apparatus taken about lines 3-3 of Fig. 5.

Fig. 4 of the drawings is a partial cross-sectional view of the present torque converter apparatus taken about lines 4-4 of Fig. 5.

Fig. 5 of the drawings is a top plan view of the present torque converter apparatus.

DETAILED DESCRIPTION OF THE DRAWINGS

While this invention is susceptible of embodiment in many different forms, there is shown in the drawings and will herein be described in detail, a specific embodiment with the understanding that the present disclosure can be considered as an exemplification of the principles of the invention and is not intended to limit the invention to the embodiment illustrated.

Torque converter 10 is shown in Figs. 3, 4 and 5 as comprising turbine shell 12, turbine shroud 14, turbine blades 16 and means 17 for joining (Fig. 3) the blade to the shell and shroud. Shell 12 includes outer perimeter 18, inner perimeter 20 and concave region 22. Concave region 22 extends between outer perimeter 18 to inner perimeter 20. Concave region 22 includes accepting region, such as accepting region 24 (Fig. 3), that extends from outer perimeter to the inner perimeter in an arcuate manner. The accepting regions may comprise recesses, among other structures. Turbine shell 12 comprises an aluminum (or aluminum alloy) material which is clad with 3xxx alloy. Additionally, shell 12 may likewise include amounts of titanium and zirconium. Of course, other aluminum-cladable materials are likewise contemplated.

Turbine shroud 14 is shown in Figs. 3 and 4 as comprising outer perimeter 26, inner perimeter 28 and convex region 30. Convex region 30 includes accepting regions, such as accepting region 32, which are configured to matingly correspond to accepting region 24. The accepting regions may comprise recesses, among other structures. Similar to turbine shell 12, turbine shroud 14 comprises an aluminum (or aluminum alloy) material which is clad with 3xxx alloy. Again

similar to turbine shell 12, turbine shroud 14 may include amounts of titanium and zirconium. Of course, other aluminum-cladable material is likewise contemplated for use.

As shown in Fig. 4, turbine blade, such as turbine blade 16, comprises lower bonding region 34, upper bonding region 36 and height 38. As will be explained below in greater detail with respect to the method of manufacturing of the torque converter, the blades are configured to matingly engage with the accepting regions of the shell and the shroud from the respective outer perimeter of each to the respective inner perimeter of each. Each of the blades may be identical in size and shape, or, there may be variances between individual blades; some may be larger, while others may be smaller.

Joining means 17, as will be explained below with respect to the method, is shown in Figs. 3 and 4 as comprising a material coating 52 on portions of each of the turbine shell, turbine shroud and turbine blade. The coating reacts to heat so that upon the application of heat, the material both chemically and metallurgically bonds the shell to the blade and the shroud to the blade. Such a material, as identified above, comprises aluminum cladding with amounts of Titanium and Zirconium. Of course, other materials are likewise contemplated.

The method of manufacturing the aluminum torque converter comprises stamping turbine shell 12. Specifically, the stock material is cut into the appropriate size, and, subsequently, concave region 22 and accepting region 24 are stamped. Once the turbine shell is stamped, the shroud is then stamped from substantially the same material from which the turbine shell is made. During the

stamping process, the appropriate shapes for the accepting region and the convex region are stamped. Of course, these members may be created through processes other than stamping. For instance, the shell and the shroud may be drawn, vacuum drawn, cast, machined, among other manufacturing processes, into the desired shape.

Turbine blades 16, which are generally identical in size and shape are stamped from aluminum stock. Just as with the shell and the shroud, the blades may be formed by a multitude of other processes, including casting and forging, to name a few.

Once all of the pieces have been stamped or otherwise formed, the final assembly procedure begins. Specifically, individual turbine blades are positioned into turbine shell 12. As shown in Fig. 3, a total of fourteen turbine blades are positioned in the corresponding fourteen recessed regions of the turbine shell. Of course, the number of blades and the number of corresponding recesses may vary for each torque converter application. Likewise, the quantity of turbine blades positioned into the turbine shell may vary -- that is, not every accepting region 24 of the turbine shell or turbine shroud must be occupied by turbine blade 16. Additionally, while various means of positioning are contemplated, the blades are preferably positioned using an inverted crown fixture (not shown) and a clamp. For instance, the blades may be individually -- and manually -- loaded into the shell.

Once the turbine blades are properly positioned into the turbine shell, the turbine shroud is then positioned and attached to the turbine shell. More

specifically, the turbine is manually positioned over the turbine blades so that the accepting regions of the turbine shroud correspond to the upper surface of the turbine blades. Once positioned, the turbine shroud is clamped to the turbine shell/blade structure. It should likewise be noted that the turbine blades may be positioned onto the turbine shroud before they are attached to the shell, or that any of the turbine blades may be positioned into either the turbine shell or the turbine shroud, as desired, as long as the "assembled" recessed regions mate with the turbine blade regions.

Once the complete assembly of the torque converter is clamped together, it becomes necessary to permanently attach these components. First, the clamped torque converter is washed and fully degreased, to remove any dirt and grease and to insure clean mating surfaces. Once fully clean and degreased, the clamped torque converter members are positioned into a CAB furnace which chemically and metallurgically joins these surfaces. The time that the torque converter is in the furnace and the temperature to which the furnace must be elevated varies with the properties of the material from which the torque converter is stamped. As such, through this process in the furnace, the blade is joined to each of the shell and shroud. Due to the nature of the joining means, the joined areas, as shown in Fig. 3, result in an exceedingly strong double filleted joint.

The contemplated apparatus and method was applied to a torque converter for use with a heavy duty truck transmission. In such an application, the turbine blades, such as blade 16, were formed from GM Alloy No. 10 with clad sides (approximately .075" thick). A turbine shroud was stamped, wherein the shroud

comprised aluminum alloy 3003-0- with recessed regions that are .04" deep and with an overall thickness of .08". A shell was stamped wherein the shell comprised aluminum alloy 3003-0- with recessed regions that are .03" deep and with an overall thickness of .06".

The unit was assembled and the components were clamped. Once clamped, the torque converter was placed into the CAB furnace. After heating in the CAB furnace for four minutes at a temperature of 601 degrees centigrade, the turbine blades were joined to each of the shell and shroud. Moreover, as shown in Fig. 5 and 6, the joined surfaces resulted in a top and bottom double fillet of .060" x 45". The bond between the turbine shroud and the turbine blade and the turbine shell was determined to be capable of withstanding 200 psi without having any fluid slip under the blades.

The foregoing description and drawings merely explain and illustrate the invention and the invention is not limited thereto, as those skilled in the art who have the disclosure before them will be able to make modifications and variations therein without departing from the scope of the invention.

CLAIMS

1. A method for manufacturing a torque converter comprising the steps of:

- forming a turbine shell having at least one accepting region;
- forming a turbine shroud having at least one accepting region;
- forming at least one turbine blade;
- positioning a portion of the at least one turbine blade into the at least one accepting region of the turbine shroud;
- positioning a portion of the at least one turbine blade into the at least one accepting region of the turbine shell;
- heating the at least one turbine blade, shell and shroud in a furnace; and
- chemically and metallurgically joining the turbine blade to the turbine shell and shroud through the application of heat.

2. The method according to claim 1 wherein the step of forming the shroud comprises the step of stamping a stock material to a desired configuration.

3. The method according to claim 1 wherein the step of forming the shell comprises the step of stamping a stock material to a desired configuration.

4. The method according to claim 1 wherein the step of forming the at least one turbine blade comprises the step of stamping a stock material into the desired

configuration.

5. The method according to claim 1 wherein the at least one turbine blade comprises a plurality of turbine blades, the step of positioning a portion of the at least one turbine blade into the shell comprises the step of positioning one of the plurality of turbine blades into each of the accepting regions of the shell.

6. The method according to claim 1 wherein the step of positioning a portion of the at least one turbine blade into the shroud comprises the step of positioning a turbine blade into each of the accepting regions of the shroud.

7. The method according to claim 1 wherein the step of heating comprises the step of placing the attached turbine shell, shroud and blade into a CAB furnace for a predetermined period of time.

8. The method according to claim 1 further comprising the step of clamping the turbine shell, shroud and blade, prior to the step of heating, to prevent inadvertent detachment of same.

9. A torque converter apparatus comprising:

- a turbine shell having at least one accepting region;
- a turbine shroud having at least one accepting region;
- at least one turbine blade having an upper region and a lower region;

- the upper region engaging the at least one accepting region of the turbine shroud, the lower region engaging the at least one accepting region of the turbine shell; and

- means for joining the upper region of the blade to the shell and the lower region of the blade to the shroud.

10. The torque converter according to claim 9 wherein the joining means comprises cladding positioned on at least a portion of the turbine blade proximate the upper region and the lower region, and positioned on at least a portion of the at least one accepting region of each of the turbine shell and the turbine shroud.

11. The torque converter according to Claim 9 wherein the turbine shell includes an outer perimeter and an inner perimeter, the turbine blade extending from the outer perimeter to the inner perimeter of the turbine shell.

12. The torque converter according to Claim 9 wherein the turbine shroud includes an outer perimeter and an inner perimeter, the turbine blade extending from the outer perimeter to the inner perimeter of the turbine shroud.

13. The torque converter according to Claim 9 wherein the at least one turbine blade comprises a plurality of turbine blades spaced evenly about the turbine shell and the turbine shroud.

Fig 1

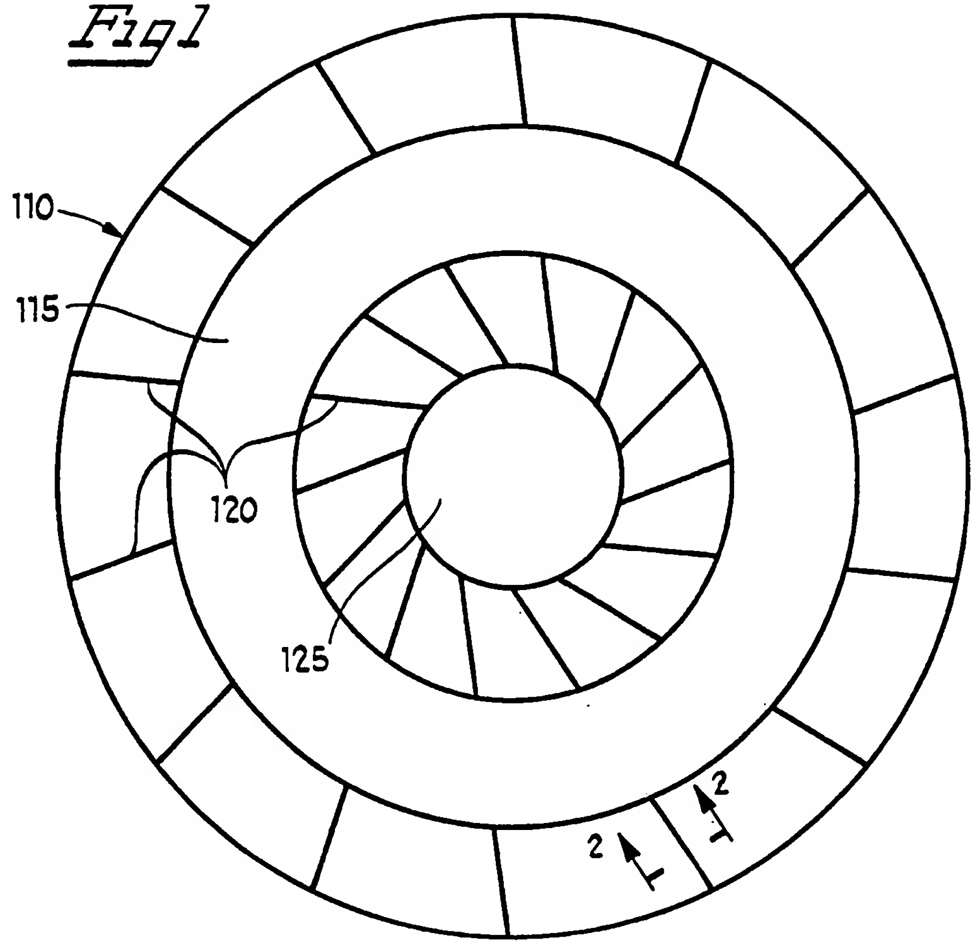


Fig 2

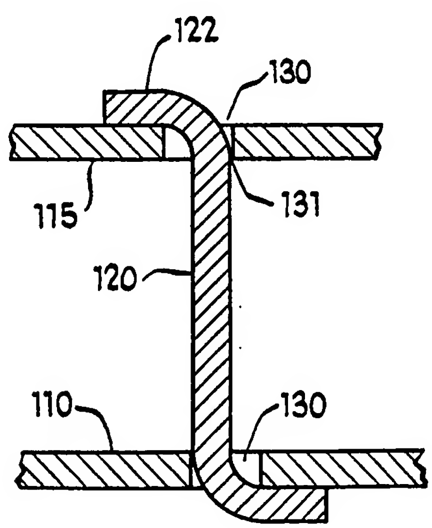


Fig 3

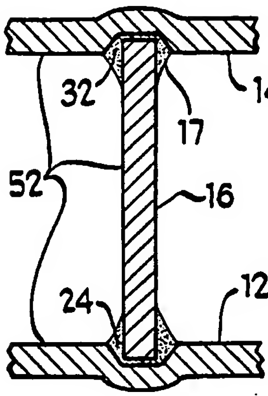


Fig 4

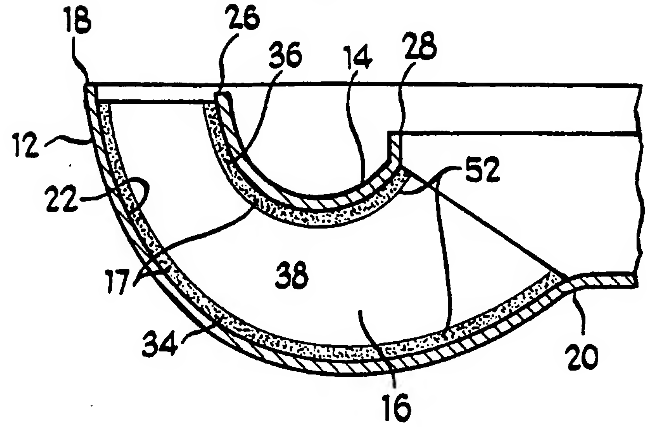
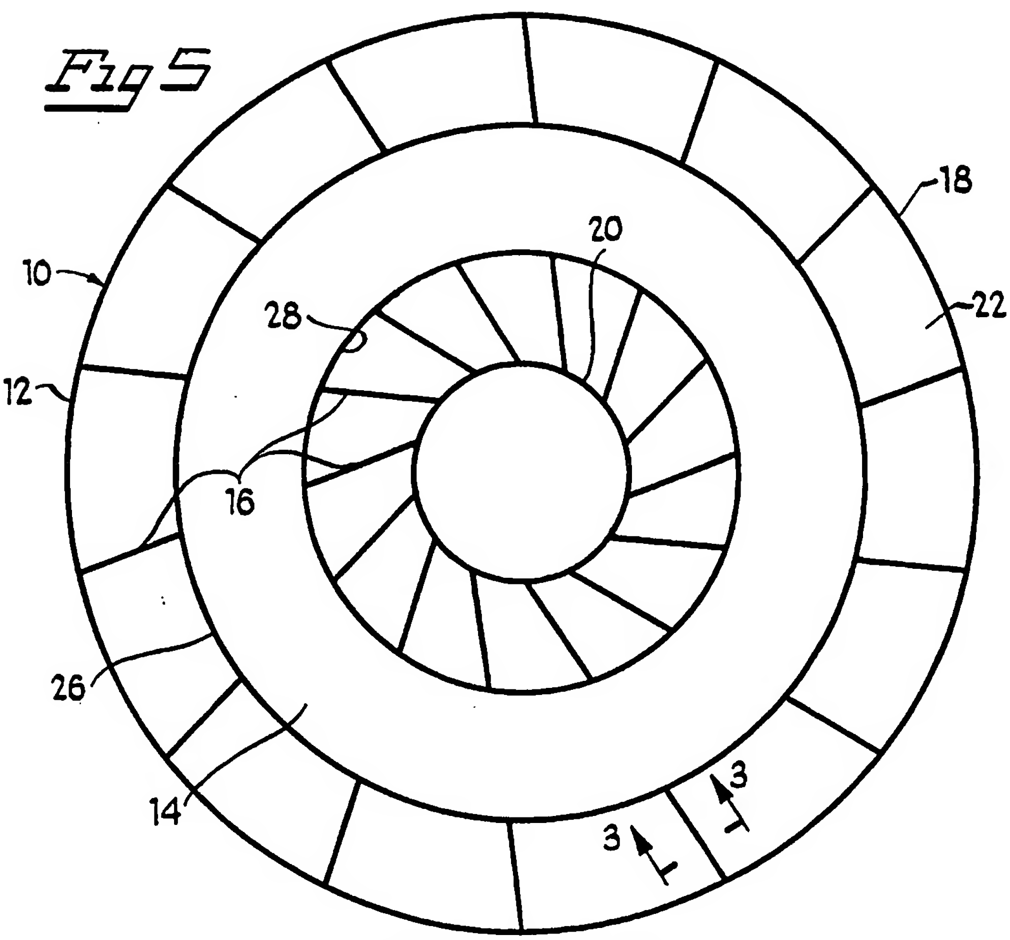


Fig 5



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US97/15803

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :F16D 33/00; B23P 15/02
US CL :60/345, 362; 416/180, 197; 29/889.5
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X — A	US 5,465,575 A (SHIMMELL) 14 NOVEMBER 1995. SEE ENTIRE DOCUMENT.	9-13 — 188
X — A	US 5,065,509 A (SAHASHI) 19 NOVEMBER 1991. SEE ENTIRE DOCUMENT.	9-13 — 1-8
X	US 3,673,659 A (ISHII ET AL.) 04 JULY 1972. SEE ENTIRE DOCUMENT.	1-13
X	US 3,708,846 A (WORNER) 09 JANUARY 1973. SEE ENTIRE DOCUMENT.	1-13
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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A	US 5,522,220 A (LOCKER) 04 JUNE 1996. SEE ENTIRE DOCUMENT.	1-13
A	US 3,986,239 A (WORNER) 19 OCTOBER 1976. SEE ENTIRE DOCUMENT.	1-13